

system consists in utilising the kitchen fire, which is almost constantly kept alight in summer and in winter. "Endeavour is made to prevent the air from entering the house at all except by the inlet provided in the lowest story of the house, with conditions available for the warming, cleaning, disinfecting, or otherwise improving the quality of the incoming fresh air, and regulating its quantity; the fresh air is then conducted into the central private hall, which is protected from smells, and all other means of pollution: it is from this private hall that the rooms draw their supply, even when the doors are shut. Having served its purpose in the rooms, the air is drawn off through the ceiling into the foul air chamber, and thence down and behind the kitchen fire, up the chimney-stack, and discharged high up in the open air, all possibility of back draught being prevented by the length and heat of the exhausting-syphon." It is a work which can be highly recommended to the officer of public health, the architect, and the householder, as a guide to the true principles of healthy ventilation. In "Sewer Gas; a Handbook on House-drainage," we have a very simple and original plan suggested for preventing noxious gases and exhalations from drains entering our houses. It is shown that these gases, being specifically lighter than atmospheric air, frequently ascend in pipes, and that they are also occasionally drawn in by the suction caused by the warmth of a house through accidental crevices in the drain pipes. It is proposed to remedy these evils by doing away with all traps except those connected with the pans of closets, and by placing a large trap in the pipe which connects the house drains with the sewer. A plan of this trap is given, showing that it is easily accessible, and can be cleaned at any time by even an inexperienced workman. The subject is one of even more importance than good ventilation. When we recollect that one of the most valued lives in Great Britain has been so recently imperilled from a mere defect in a system of drainage, we cannot too highly estimate the efforts of those who suggest, both by precept and experiment, the adoption of such measures as will ensure the safety of all sensible householders.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

Hindrances to Students of Mathematics

It was the opinion of Dr. Samuel Johnson that everything ought to be persecuted in order that we may know whether it is worthy to live or not. There is, doubtless, a good deal of truth in this opinion, and the idea or the man that cannot endure and overcome a considerable amount of difficulty is of but little value. Still there must be a reasonable limit to persecutions and difficulties, and hence I hope that the praiseworthy efforts of the English mathematicians to improve their text-books of geometry will be successful. In considering such a matter as the improvement of text-books, an extensive knowledge of the experience of all classes of students will be valuable, and as many of the mathematical books profess to be written for those who are not fortunate enough to have a teacher, an account of the difficulties which such a one has experienced may be of some interest.

1. I place first among these difficulties the practice common to nearly all mathematical writers, of restricting the number of axioms or fundamental assumptions, making them fewer than they naturally are. It is worse than useless to attempt to prove something that is self-evident, or which is so nearly so that it is impossible to make any proof illustrate it. In all such cases it would be better to state frankly and clearly that we make an assumption, depending on observation to justify it. An example of this superfluous proof may be found in many of the books on rational mechanics, where we are told that a body cannot move out of the plane of the forces, because we know of no reason why it should move to one side rather than the other; therefore, &c. Of useless definitions we have an example in a popular

work on arithmetic, where we are told that "time is the measurement of duration," and a few pages further on that "duration is a portion of time." Allied to this is the contemptible habit of those who explain, with kind condensation and with great detail, all insignificant matters, while at the same time they cover up or dodge by some such phrase as "it is evident" the really difficult points.

2. I do not object to a frequent and thorough application of the differential calculus in a text-book, and such an application seems to me better than the coarse processes under which this calculus is sometimes concealed; but there is a habit, common to young writers, of introducing forced and difficult demonstrations where more simple ones would be better. An illustration may be found in one of our best books on astronomy. In the first edition of this book the author gave a long and difficult demonstration of the well-known formulæ for the transformation of rectangular co-ordinates in a plane. The demonstration was made to depend on the solution of functional equations by means of the differential calculus, and is an awkward thing to place at the beginning of a text-book. In the second edition, having removed this demonstration and supplied its place by a simple one, the author has made the first chapter of his book the best synopsis of spherical trigonometry that I know of.

3. An error of the English text-books written by Cambridge men is, I think, the great number of examples given at the close of each chapter. At least one-half of these should be omitted. It is a great mistake to keep the student lingering over the never-ending questions of conic sections, of maxima and minima, &c., and to give him the habit of solving petty problems, when he should be led forward as soon as possible to the study of the memoirs of those who have created the science. In this connection it seems to me a mistake in treating the differential calculus to confine ourselves rigorously to the notion of a limit. Although the doctrine of limits may be the only logical foundation of this calculus, the student as he advances must soon become familiar with differentials, and it is well that he should make their acquaintance in his text-book.

4. A defect, perhaps of teaching rather than of text-book, is the ignorance of all American students of numerical and logarithm calculations, and from my slight observation I infer that such is the case also with English students. It is not uncommon to hear such calculations spoken of with contempt, but there is nothing that gives one a clearer idea of the meaning of analytical formulæ than to make a numerical application of them. In this matter it seems to me that the assistance of a teacher is of much more importance than in dealing with theoretical difficulties, since with these a student must generally be left to himself, while a little advice from a skilful computer will save the beginner much time and trouble.

5. Finally I mention, as a source of some confusion and perplexity to the student, the changes of notation and the introduction of new names. Some such change and inventions will be necessary with the progress of science, but any which tend to mar the symmetry of analytical expressions, and render less easy the reading of the great mass of mathematical literature that we already possess, should be avoided. To call a well-known function a "wonnunetomy," or a "subcontra-wonnunetomy," does not of course endow it with any new properties, or make its discussion one whit easier, although we may gain a slight advantage in the way of brevity of reference. For my own part I hope that this introduction of words of thundering sound, and the calculation of almost interminable formulæ, for which no more ingenuity is required than for a numerical calculation, is only premonitory to the invention of a calculus of operations which shall furnish us with shorter and more powerful methods of investigation.

ASAPH HALL.

Washington, August 16

Jeremiah Horrocks

In the course of research (for literary purposes) concerning Jeremiah Horrocks, the astronomer, born at Toxteth, near Liverpool, 1619, I have been unable to discover his parentage. Could any of your readers help me in this matter?

London, Aug. 12

E.

The "Mors Electrique"

WITH reference to your notice of M. Sidot's "Mors Electrique," I may mention that in India it has been proposed to use Magneto Electricity for the purpose of starting a jibbing horse,

by passing a spark between two points attached to the breeching. I believe this would be really practicable and useful.

August 9

J. F. TENNANT

MAGNETICAL AND METEOROLOGICAL WORK AT BOMBAY

WE have received from Mr. C. Chambers, F.R.S., the Director of the Colaba Observatory, Bombay, three memoirs, to appear eventually as appendices to the volume; observations dealing with (1) the Absolute Direction and Intensity of the Earth's Magnetic Force at Bombay, and its Secular and Annual Variation, (2) on the Lunar Variations of Magnetic Declination at Bombay, and (3) a description of a new Self-Registering Rain Gauge. In the first memoir Mr. Chambers refers to the diminution of terrestrial magnetic action with increase of height above the ground. He states, "I am aware that experiments have at times been made to determine the effect upon the terrestrial magnetic force, of change of elevation or depression, both upon mountains and in mines; and it may be that such have been made also upon high buildings; but excepting the observations made in the vaults of the Paris Observatory, which I have not seen any discussion of with reference to this point, I believe that no long series of observations—capable of detecting small differences of the kind now pointed out—have been made elsewhere than at Bombay; and that the facts so strongly brought to light by the Bombay observations have not previously been forcibly commented on. It has now been shown—by the discussion of independent observations in each case—that diminution of effect with increase of height extends to—(1) the Secular Variation of Declination, (2) the Secular Variation of Horizontal Force, and (3) the Diurnal Inequality of Horizontal Force. Consistent testimony of this kind—even allowing for the possibility of explaining the first case on a different hypothesis—gives probability to the supposition that the phenomenon of sensible diminution of terrestrial magnetic action with moderate and practically attainable elevations above the earth's surface is general."

The object of the new rain gauge is to produce a complete record of rain-fall by means of photography, with this additional advantage, that whenever a barometer is kept in continuous operation there need be no additional expense in working the rain gauge.

SCIENCE IN JAPAN *

PROF. W. E. GRIFFIS writes us a very encouraging letter from Fukuwi, Japan, where he is giving practical instruction in a chemical laboratory established a year ago. Sixty students attend his daily lectures on chemistry and physics, properly illustrated by experiments, and twelve students do actually practise in the chemical laboratory. What he says of Japan is equally true here in the United States, only that the rubbish of astrology and Chinese philosophy, which prevent rapid progress there, are here represented by notions not less common nor less obstinate. He says:—"In teaching physical science in Japan, one has need to begin at the lowest foundation, to demonstrate everything, and to clear away much rubbish of astrology, Chinese notions of philosophy, falsely so called, &c.; yet the students are fairly intelligent, and promise hopefully to fill, in some measure, the greatest educational need of the country—good teachers."

The following will also merit attention:—"It may please you to know that Japan, just entering upon her course of modern civilisation, has begun by not only assigning a

foremost place to physical science in her schools, but has already established several laboratories, in which students receive practical instruction from German and American professors. The chief laboratory in Osaka is presided over by a German professor, having nearly one hundred students. Another laboratory, it is expected, will be established in Yeddo. There is one in the province of Kaga, in charge of a German professor; another, also under a German, is at Shidzoka, in the province of Suruga. The laboratory in Fukuwi, province of Echeyen, has been established nearly a year." This is the laboratory of Prof. Griffis, above spoken of.

It gives us, indeed, great pleasure to record these significant evidences of progress in the far-off Japan. These facts, as well as many others, show that at length commerce, the arts, and physical science, have commenced their missionary career in Japan, and will soon introduce the blessings of civilisation in that great country leaving the Japanese and Chinese gods to take care of themselves, if they can.

THE "HASSLER" EXPEDITION

THE GALAPAGOS ISLANDS

THE numbers of NATURE for July 11 and 18 contain reports from Prof. Agassiz himself of his *Hassler* Expedition; we are glad to be able to furnish the following continuation of these reports from a writer in the *New York Tribune* who accompanies the Expedition:—

"About sundown on Thursday June 6 we bade good-bye to the Ossipee and to Payta, and, with a fair wind and smooth sea, started for the Galapagos. Darwin's account of this archipelago had excited our curiosity and interest to the highest degree. Of course our visit was all too short to settle the many interesting questions which his narrative suggests. We landed on Charles early Monday afternoon, June 10, and left early Wednesday morning. We landed at Tagus Cove, on Albemarle, Thursday morning, and remained until Friday afternoon. On Saturday at noon we anchored off James Island, and remained until Sunday at 10 o'clock, when we visited Jervis Island, and remained until sunrise on Monday. We anchored at Indefatigable Island on Monday by 9 o'clock A.M., and were detained repairing our engine until Wednesday afternoon, June 19, when we started for Panama. In so brief a visit to so remarkable an archipelago, no conclusions can properly be drawn from what we did not see, and yet one of the most interesting points of inquiry was precisely one that can be definitely settled by negative testimony only—the inquiry whether plants and animals found on one island are wanting on the other islands in the group. That this should be the case is not incredible; even on the continent we sometimes find plants and animals confined to very narrow localities. And although we had a very limited opportunity to examine the five islands on which we landed, our observations, as far as they go, tend to confirm the statements heretofore made that the Galapagos have a fauna and a flora decidedly of an American type, yet decidedly peculiar to themselves, and that even each island differs from the other islands; nay, that this difference extends, in some degree, to the fishes in the bays around their shores.

"The islands are to my eye much more recent in their formation than Juan Fernandez. Indeed, Narborough and Albemarle have so fresh a look that you could easily believe that there had been extensive eruptions there within the present century. Immense domes, 4,000 to 5,000 feet high, stand upon very flat truncated cones, twelve or fifteen miles in diameter. Over the whole surface of such mountains are scattered craters, chimneys, and small truncated cones. From many of these craters streams of lava have flowed toward the sea, some of them

* From the Iowa "School Laboratory of Physical Science."